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VULNERABILITY AND RESILIENCE TO CLIMATE CHANGE IN SOUTHERN HONDURAS: ANNEXES

DECEMBER 2013

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ARCC



African and Latin American
Resilience to Climate Change Project

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Cover Photo: Looking up the valley of the Río Tiscagua, a tributary of the Río Negro, toward Concepción de Maria and Cerro Guanacaure. Photo by B. Byers, September 2013.

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VULNERABILITY AND RESILIENCE TO CLIMATE CHANGE IN SOUTHERN HONDURAS: ANNEXES

AFRICAN AND LATIN AMERICAN RESILIENCE TO CLIMATE CHANGE (ARCC)

DECEMBER 2013

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ABBREVIATIONS AND ACRONYMS

ACTRIGOLFO	<i>Asociación Civil Trinacional del Golfo de Fonseca</i>
AECID	<i>Agencia Española de Cooperación Internacional para el Desarrollo</i>
AFE-COHDEFOR	State Forest Administration-Honduran Forest Development Corporation
ANAFAE	<i>Asociación Nacional Para el Fomento de la Agricultura Ecológica en Honduras</i>
ANDAH	Honduran Aquaculture Association
APM	Agricultural Policies and Markets
APROCAFEH	<i>Asociación de Productores de Café de Honduras</i>
ARCC	African and Latin American Resilience to Climate Change
ASONOG	<i>Asociación de Organismos No Gubernamentales de Honduras</i>
CATIE	<i>Centro Agronómico Tropical de Investigación y Enseñanza</i>
CCAD	<i>Convención Centroamericana de Ambiente y Desarrollo</i>
CEM	Center for Marine Studies
CIDICCO	<i>Centro Internacional de Información sobre Cultivos de Cobertura</i>
CODDEFFAGOLF	<i>Comité para la Defensa y Desarrollo de la Flora y Fauna del Golfo de Fonseca</i>
COMRURAL	<i>Proyecto de Competitividad Rural</i>
CONABISAH	Comisión Nacional de Bienes y Servicios Ambientales
CRSP	Collaborative Research Support Program
DGRH	<i>Dirección General de Recursos Hídricos</i>
DiBio	<i>Dirección de Biodiversidad</i>
DIGEPESCA	<i>Dirección General de Pesca y Acuicultura</i>
DOC	U. S. Department of Commerce
EAP	<i>Escuela Agrícola Panamericana</i>
ENSO	El Niño -Southern Oscillation
ESRI	Eco-Social Resilience Index
FAO	Food and Agriculture Organization
FAPVS	<i>Fondo de Áreas Protegidas y Vida Silvestre</i>
FHIA	<i>Fundación Hondureña de Investigación Agrícola</i>

GOH	Government of Honduras
HDI	Human Development Index
HIVOS	Humanist Institute for Cooperation
ICF	<i>Instituto Nacional de Conservación y Desarrollo Forestal, Areas Protegidas y Vida Silvestre</i>
IDH	<i>Índice de Desarrollo Humano</i>
IHCAFE	<i>Instituto Hondureño del Café</i>
IPCC	Intergovernmental Panel on Climate Change
JAPOE	<i>Juntas de Administradora de Agua Potable y Disposición de Excretas</i>
LUPE	Land Use and Productivity Enhancement
MAFRON	Union of Municipalities of the Boarder
MAREA	Management of Aquatic Resources and Alternative Development
MIRA	<i>Manejo Integrado de Recursos Ambientales</i>
MODIS	Moderate Resolution Imaging Spectroradiometer
NASMAR	<i>Mancomunidad de Municipios del Sur</i>
NGO	Nongovernmental Organization
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
OIMT	<i>Organización Internacional de las Maderas Tropicales</i>
OSPESCA	<i>Organización del Sector Pesquero y Acuicola del Istmo Centroamericano</i>
PREPCA	Regional Energy & Poverty Program in Central America
PRNM	<i>Proyecto Manejo Recursos Naturales</i>
PROARCA	<i>Programa Ambiental Regional para Centroamérica</i>
PRONAFOR	<i>Programa Nacional Forestal</i>
RCP	Recommended Concentration Pathway
SAG	Ministry of Agriculture and Livestock
SANAA	<i>Servicio Autónomo Nacional de Acueductos y Alcantarillados</i>
SEPLAN	<i>Secretaría Técnica de Planificación y Cooperación Externa</i>
SERNA	<i>Secretaría de Recursos Naturales y Ambiente</i>
SINAPH	<i>Sistema Nacional de Áreas Protegidas y Vida Silvestre de Honduras</i>
SMN	<i>Servicio Meteorológico Nacional</i>

TNC	The Nature Conservancy
TRMM	Tropical Rainfall Measuring Mission
UNAH	<i>Universidad Nacional Autónoma de Honduras</i>
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USD	United States Dollars
USFS	United States Forest Service

ANNEX A. GUIDE TO QUESTIONS FOR MUNICIPALITIES

GUÍA DE PREGUNTAS PARA LAS MUNICIPALIDADES

Datos generales del municipio

Nombre del entrevistado:

Número de teléfono:

Comunidad:

Departamento:

Número de aldeas del municipio:

Número de habitantes del municipio:

Área del municipio:

Medios de vida

¿De qué depende la economía local y si nos podría dar un porcentaje estimado de la población por sector o rubro?

	Porcentaje de la población estimada
Granos básicos	
Frutas, ¿Cuáles?)	
Horticultura	
Caficultura	
Ganadería	
Pesca	
Caña	
Melón	

Sandía	
Acuacultura (Camarón)	
Acuacultura (Tilapia)	
Jornaleros, (¿en qué?)	
Comercio	
Turismo	
Artesanías locales	
Salineros	
Remesas	
Microempresa	
Minería	
Otros:	

¿Cuáles son las tres áreas que generan más ingresos para la municipalidad?

Actividad económica	% de los ingresos

¿Cuáles son las tres actividades económicas que generan más empleo en el municipio?

Actividad económica	% de la población

¿Tienen plan de desarrollo económico local?: Si ____; No ____ ¿nos pueden facilitar una copia?

Agua

¿Cuáles son sus fuentes de agua para consumo humano?

Fuente	Número de usuarios (No. casa)	Horas por día de uso de agua en las viviendas	Zonas que utilizan esa fuente de agua
Cerro Guanacaure			
Cerro La Botija			
Posos			
Ríos y Quebradas			
Otros:			

¿Tiene problemas de calidad?

Problemas	Magnitud (media, alta, y baja)
Turbidez	
Salinidad	
Contaminación por pesticidas	
Contaminación bacteriológica	
Otros: Minas	

¿Cuál es el área irrigada del municipio?

Cultivo	Área irrigada por cultivo
Melón	
Sandía	
Frutales, ¿cuáles?	
Hortalizas	
Caña	

Cambio climático y vulnerabilidad

¿Cuál es su percepción del cambio climático y adaptación al mismo?

¿Cómo están abordando el cambio climático a nivel municipal?, en caso que no se esté considerando, ¿por qué no?

¿Cuál son los eventos climáticos que han afectado al municipio?

Tipo de fenómeno	No. de eventos en los últimos 15 años	Daños causados
Tormentas intensas y huracanes		
Deslizamientos		
Inundaciones		
Sequías		
Incendios		

¿Existen CODEM?, Si _____ No _____ ¿Existen CODELES?, ¿Cuántos? _____

¿Existe algún plan de contingencia o emergencia municipal? Si _____ No _____, ¿pueden facilitar una copia?

¿Tienen una partida presupuestaria para prevención de desastres (reforestación, obras de infraestructura etc.?)

¿Tienen personas capacitadas para atender emergencias?

¿Tienen un lugar que brinde refugio a los potenciales damnificados?

¿Tienen sistemas de información meteorológica?

En caso de emergencia, ¿Qué tipo de ayuda reciben y de qué institución?

Instituciones	Tipo de ayuda que brinda
COPECO	
Iglesias	
Otros:	

¿Existe algún programa o unidad de la alcaldía para capacitar a los habitantes ante fenómenos naturales?

¿Existe algún programa para apoyar a la comunidad para adaptarse al cambio climático?:

Opciones	Coloque una marca si la municipalidad tiene alguna opción
Programa/oficina con presupuesto de desarrollo económico local	
Plan de ordenamiento territorial	

Opciones	Coloque una marca si la municipalidad tiene alguna opción
Asistencia técnica para cambio de patrones de cultivos y uso del suelo	
Apoyo para sistemas de riego	
Incentivos para el buen manejo del suelo: barreras vivas y muertas, curvas a nivel, etc.	
Incentivos para reforestar	
Otras:	

ANNEX B. INTERVIEW GUIDE FOR KEY ACTORS AT THE COMMUNITY LEVEL

ENTREVISTA ACTORES CLAVES A NIVEL COMUNITARIO

Datos generales del entrevista	
Comunidad:	Fecha:
Nombre del entrevistado:	Organización:
Posición o cargo:	Email:
Teléfono:	

Bienes y servicios de los ecosistemas marino-costeros			
1. ¿Cuáles son las principales actividades productivas de la comunidad?			
2. ¿Cuáles de los recursos marino-costeros que se utilizan? ¿Qué tipo de uso se le está dando a cada recurso?			
Recurso	Usos	Recurso	Usos
3. De acuerdo al uso y la importancia que tienen los siguientes recursos, Qué valor le asignaría (alto, medio o bajo):			
Bosques _____	Manglares _____	Fuentes de agua _____	
Playas _____	Humedales _____	Recursos marinos _____	
Suelo _____			

Madera _____	Leña _____	Otro: _____
--------------	------------	-------------

Amenazas a los Recursos:

Enumere las principales amenazas a los recursos en su comunidad.

Recursos	Amenaza 1	Amenaza 2	Amenaza 3	Amenaza 4
Bosques				
Playas				
Leña				
Madera				
Fuentes de agua				
Suelo				
Manglares				
Humedales				
Recursos Marinos				
Otros				

Demografía Familiar

I. ¿Cuántas personas viven en su vivienda? Menores de 15 años _____ Adultos _____
Total _____

Miembro del hogar	Edad	Género	Nivel Educativo	Ocupación Primaria	Ocupación Secundaria
1. Jefe del hogar		1. Mujer	0. Ninguno	1. Pesca	1. Pesca
2. Esposo(a)		2. Hombre	1. Primaria	2. Agricultura	2. Agricultura
3. Hijo(a)			2. Secundaria	3. Comercio	3. Comercio
4. Yerno/Nuera			3. Técnica	4. Servicios/Oficios	4. Servicios/Oficios

5.Suegro(a) 6.Nieto(a) 7.Otro			4.Universitaria 5.Otra	5.Asalariado público 6.Asalariado privado 7.Otro	5.Asalariado público 6.Asalariado privado 7.Otro
--	--	--	---------------------------	--	--

Ingreso Familiar

Actividad Económica	Contribución Ingreso/Comida	Todo el año/ Algunos meses	Tiempo completo/ Medio tiempo	% del ingreso del hogar

2. ¿Recibe usted algún tipo de ayuda de algún familiar que reside fuera del hogar? Si ☐ No ☐

3. Si es así, ¿Qué proporción del ingreso del hogar proviene de remesas? _____

Percepciones:

4. ¿Si en el futuro se redujeran o se colapsaran las pesquerías (peces, curiles, cangrejos), que haría para sostener a su familia?

Como afectan su actividad económica (pesca, curileo, ganadería, agricultura, camarones, salineros) los siguientes eventos climáticos. Qué valor le asignaría (alto, medio o bajo):

Tormentas intensas y huracanes	A, M, B	¿De qué forma se ve afectada su actividad económica?
Deslizamientos		
Inundaciones		
Sequias		
inundaciones		

Conocimientos y actitudes hacia el cambio climático

5. Durante los últimos años, ¿Considera usted que el clima ha cambiado? En caso afirmativo ¿A que cree que se deben esos cambios?

6. ¿Ha oído hablar del "cambio climático"? En caso afirmativo, ¿Qué sabe usted al respecto?

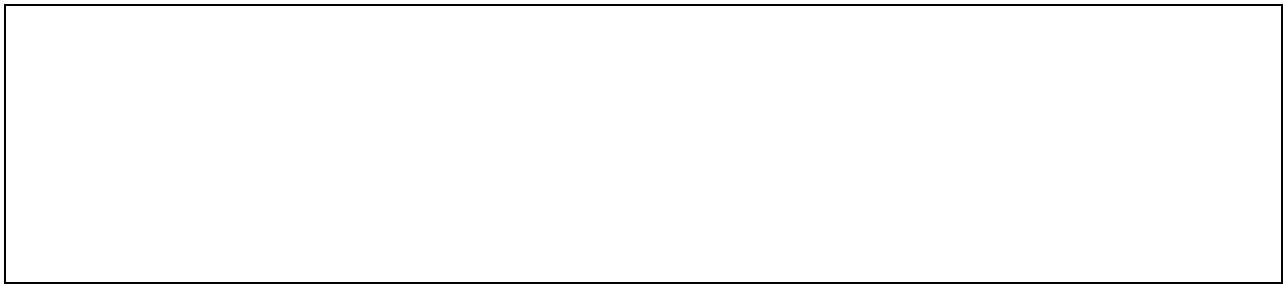
7. ¿Qué cree usted que causa el cambio climático? ¿Cuáles cree usted que son las causas del cambio climático?

8. ¿Qué fenómenos naturales considera usted que están vinculados con el cambio climático?

9. ¿Qué efectos o impactos cree usted que tiene el cambio climático?

10. ¿Qué actividades productivas cree que empeoran los efectos del cambio climático en el Golfo?

<p>11. ¿Cuáles cree usted que son los riesgos que enfrenta su comunidad asociados con el cambio climático?</p>
<p>12. ¿Usted o su comunidad han sido afectados por el cambio climático? Si su respuesta es afirmativa, ¿Cómo les ha afectado el cambio climático? ¿Qué impactos ha tenido sobre su hogar, sobre su comunidad y sobre los recursos marino-costeros del Golfo?</p>
<p>13. ¿Qué tan preparado está usted o su comunidad para los peligros relacionados con el clima?</p>
<p>14. Durante los últimos 10 años, ¿Usted o su comunidad ha sido afectada por huracanes o inundaciones? En caso afirmativo, ¿Qué ha hecho para solventar los problemas que estos fenómenos causan?</p>
<p>15. ¿Cree que se puede hacer algo para reducir los impactos del cambio climático? ¿Considera que su organización o comunidad pueden realizar acciones para hacer frente a los problemas del cambio climático? ¿Qué tipo de acciones se podrían implementar?</p>
<p>16. ¿Está su organización o comunidad involucrada de alguna manera en el desarrollo de las políticas gubernamentales en materia de cambio climático?</p>
<p>Comentarios finales:</p>



ANNEX C. AGENDA FOR WORKSHOP WITH KEY ACTORS FROM UPPER WATERSHEDS

AGENDA

DISCUSIÓN CON ACTORES CLAVE DEL DEPARTAMENTO DE CHOLUTECA

ZONAS ALTAS DE LAS CUENCAS

2 DE OCTUBRE DE 2013

Hora

9:00 A.M.	Bienvenida y presentación de cada participante
9:20 A.M.	Orientación: Objetivo de la reunión Revisión de la agenda Trabajo de grupos
9:35 A.M.	Dividirse en cuatro grupos por niveles: representantes de las comunidades, municipalidades, ONGs, Agencias del Gobierno Nacional. Los grupos discutirán los efectos de los escenarios del cambio climático y su impacto en los medios de vida, y en los bienes y los servicios de los ecosistemas.
10:20 A.M.	Merienda
10:30 A.M.	Presentación - <u>resumen</u> del trabajo de grupo en función de los puntos clave (5 minutos por grupo).
10:50 A.M.	Breve discusión en plenaria (todos los participantes).
11:00 A.M.	Dividirse en cuatro grupos de trabajo integrados por representantes de las comunidades, municipalidades, ONG, y Agencias del Gobierno Nacional. Los grupos identifican las cinco acciones/opciones más importantes para adaptarse a los cambios climáticos potenciales.

11:30 A.M.	Los grupos presentan las listas conteniendo las cinco acciones prioritarias para la adaptación al cambio climático.
11:40 A.M.	Discusión en plenaria de las acciones/opciones para adaptarse a los cambios climáticos potenciales.
12:15 P.M.	Conclusiones y palabras de cierre
12:20 P.M.	Almuerzo

ANNEX D. AGENDA FOR WORKSHOP WITH KEY ACTORS FROM THE COASTAL-MARINE ZONE

AGENDA

DISCUSIÓN CON ACTORES CLAVE DEL DEPARTAMENTO DE CHOLUTECA Y VALLE

ZONAS MARINO COSTERO

3 DE OCTUBRE DE 2013

Hora

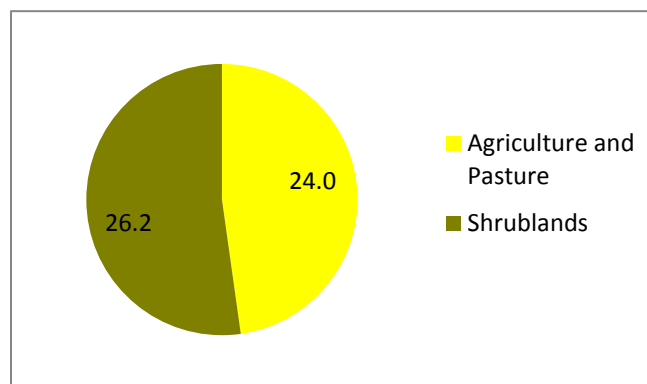
9:00 A.M.	Bienvenida y presentación de cada participante
9:20 A.M.	Orientación: Objetivo de la reunión Revisión de la agenda Descripción de las tres condiciones climáticas
9:35 A.M.	Los grupos discutirán los efectos de las próximas condiciones climáticas, su impacto en los medios de vida, y en los bienes/servicios de los ecosistemas, para lo cual se formarán cinco grupos de trabajo: Organizaciones comunitarias Productores agrícolas Pescadores y curileros ONGs y programas Gobierno regional y alcaldías
10:35 A.M.	Merienda

10:45 A.M.	Presentación de los efectos - <u>resumen</u> del trabajo de grupo (5 minutos por grupo).
11:10 A.M.	Trabajar en los mismos grupos respondiendo las preguntas sobre “capacidades” en la actividad número 2.
12:10 P.M.	Presentación sobre “capacidades” (5 minutos por grupo)
12:35 A.M.	Discusión en plenaria de las acciones/opciones sobre capacidades
12:45 P.M.	Conclusiones y palabras de cierre
1:00 P.M.	Almuerzo

ANNEX E. REPRESENTATIVE COMMUNITY PROFILES

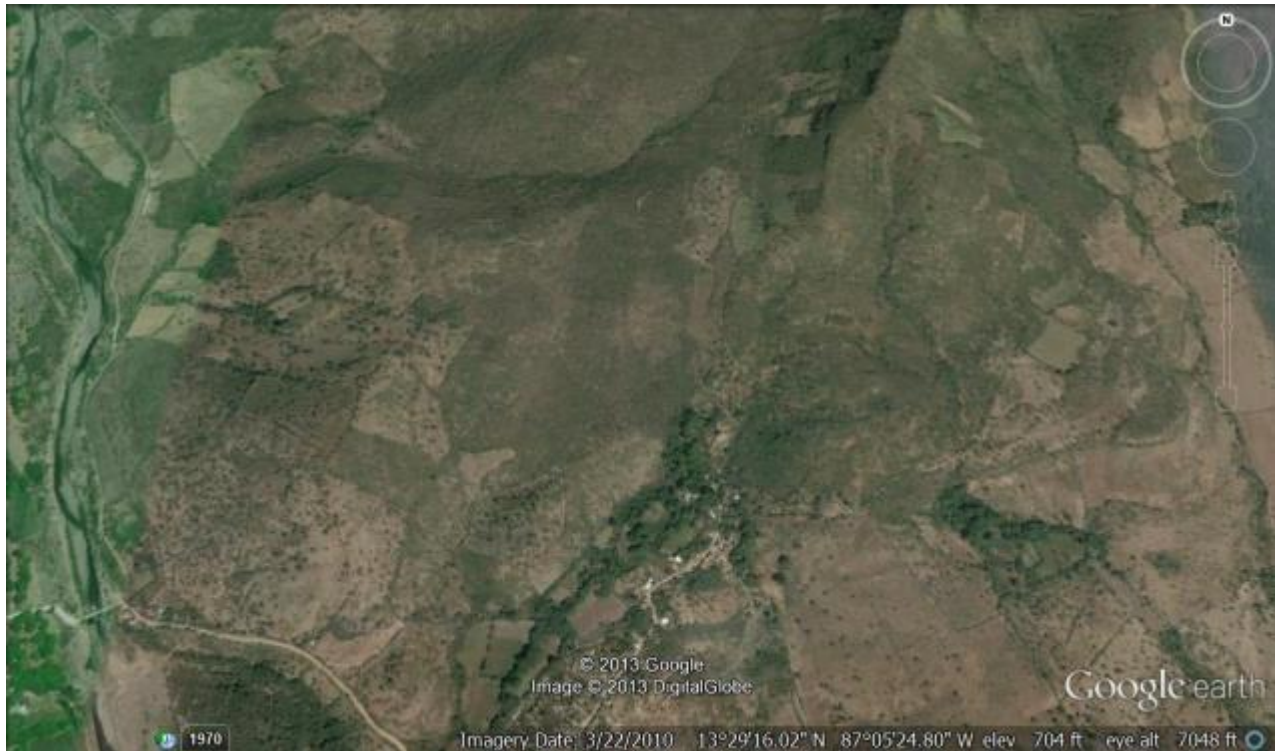
SANJONES AND EL ARENAL COMMUNITIES, MUNICIPALITY OF APACILAGUA

**LAND COVER/USE FOR SANJONES AND EL ARENAL COMMUNITIES IN THE
MUNICIPALITY OF APACILAGUA**



Apacilagua is located about 25 km northeast of Choluteca, not far from Orucina, on the western side of the Río Choluteca. This zone is the driest in Honduras; it is located in the rain shadow of the highlands to the north. The visited communities have a population of about 1,250 people in 250 households. There are no protected areas nearby.

GOOGLE SCREENSHOT OF COMMUNITIES WEST OF APACILAGUA



Livelihoods here are completely based on growing basic grains — maize, beans, and sorghum — and small-scale livestock keeping. All families in the communities engage in these activities, which provide income and food for them. Sixty percent of household income comes from growing and selling basic grains, and 30 percent comes from sales of livestock (cattle, pigs, and chickens). The average family cultivates between 1.5 and 3.5 hectares, 70 percent of which is not owned by them but share-cropped. Crops are grown mostly on valley and hill slopes using traditional methods. Soils have low fertility, soil conservation measures are not used, and inputs such as fertilizer and pesticides generally are not used. The average family has from three to five cattle. Almost no one here grows vegetables or fruits. Because of isolation and poor roads, almost no one works as laborers in commercial agro-industries farther to the south. When young people graduate from secondary school, they generally migrate to other parts of Honduras. About 10 percent of household income here comes from remittances from relatives working elsewhere in Honduras.

Water is very scarce here and mostly comes from springs. This water is used for domestic purposes only. There is no potential for irrigation from surface water. Communities in the area have purchased about 20 hectares of land in zones of recharge for these springs.

People in these communities have not been involved in projects such as CARE PROSADE or Emprendesur.

APACILAGUA SHRUBLANDS



Photo by L. Caballero, November 2013

RÍO CHOLUTECA NEAR SAJONES COMMUNITY



Photo by L. Caballero, November 2013

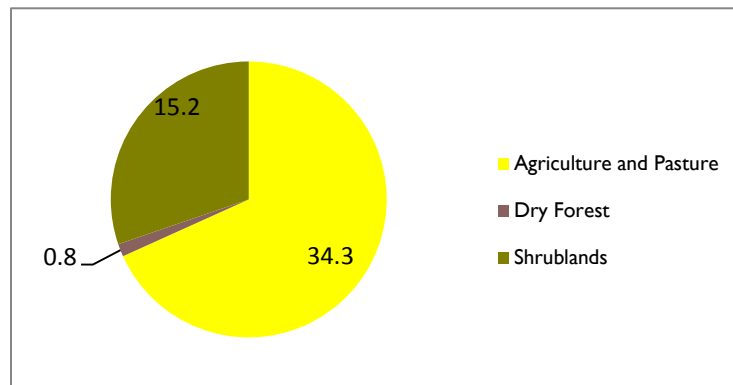
MAIZE FIELD NEAR SAJONES COMMUNITY



Photo by L. Caballero, November 2013

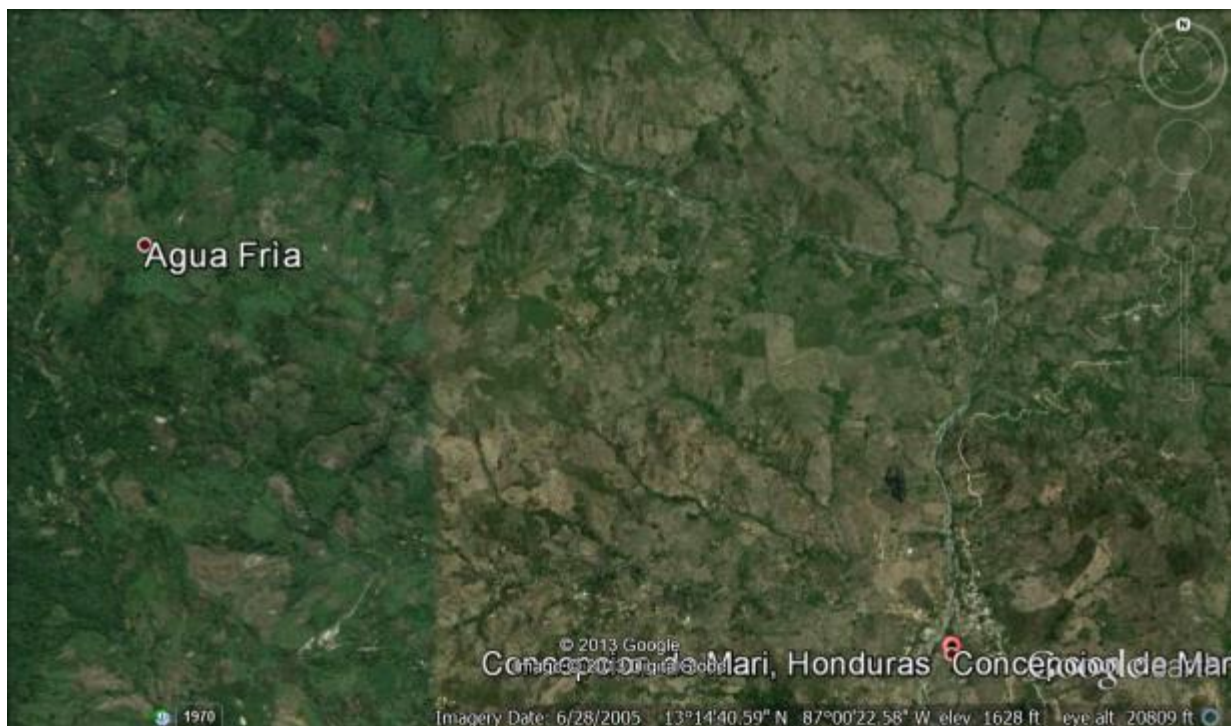
LAS TROJAS COMMUNITY IN THE MUNICIPALITY OF CONCEPCIÓN DE MARIA

LAND COVER/USE FOR LAS TROJAS IN THE COMMUNITY OF CONCEPCIÓN DE MARÍA



Las Trojas is a community in the watershed of the Río Tiscagua, one of the tributaries of the Río Negro. The river starts on Cerro Guanacaure, a multiple-use protected area that is within the Municipality of El Corpus. About 20,000 people live in about 3,500 households in the valley. The landscape is about 25-percent forested here according to community members (note, however, that Moderate Resolution Imaging Spectroradiometer [MODIS] satellite-based image analysis puts the permanent cover ratio of the entire municipality at only 4 percent). Concepción de María, the municipal center, is about 40 km by road from Choluteca.

GOOGLE SCREENSHOT SHOWING CONCEPCIÓN DE MARIA AND THE VALLEY OF THE RÍO TISCAGUA ABOVE IT



The micro-watershed of the Río Tiscagua has an area of about 8,000 hectares, with about 2,000 hectares of maize and sorghum and about 850 hectares of beans. These crops are only grown during the wet season. About 90 percent of families here grow basic grains, about 60 percent of which is eaten directly; 40 percent is sold in local and regional markets. About 30 percent of producers have metal silos in which they store grains after harvest. Basic grain crops are often planted on steep slopes, and soil erosion is a problem. When soils erode they lose their fertility, and production decreases.

Keeping livestock is the other major livelihood activity here. For this purpose, the valley has approximately 1,400 hectares of pastures that were originally cleared from forest. Many of these hectares are burned to keep them from reverting to forest. About a quarter of the pastures belong to small producers, but the majority belongs to large producers. Ten percent of families here engage in livestock keeping both for food and for sale, and around 40 percent of household incomes come from livestock sales – the same percentage as for sales of basic grains.

Some fruits (e.g., avocado, mango, mandarins, oranges, and lemons) and vegetables (e.g., tomatoes, chile, and squash) are grown for consumption and sale in regional markets (El Triunfo, Choluteca).

Community members estimated that about 60 percent of adults from the area take seasonal work in commercial agro industries in the coastal areas below or are involved in artisanal mining. About 5 percent of families here receive remittances.

People here depend on wood from the forests for cooking, building houses, and making furniture. In some places wood is scarce, and mango wood is cut for building; however, its quality is poor for this purpose.

Respondents said they had noticed changes in the climate in recent years, including higher temperatures, less fog, and much stronger winds during November to January.

**RÍO TISCAGUA NEAR ITS CONFLUENCE WITH THE RÍO NEGRO, LOOKING
UPSTREAM TOWARD CONCEPCIÓN DE MARIA**



Photo by B. Byers, September 2013

BEANS, MAIZE, AND FALLOWED FIELDS ABOVE CONCEPCIÓN DE MARIA



Photo by B. Byers, September 2013

**MAIZE PLANTED ON A STEEP SLOPE ABOVE THE RÍO TISCAGUA, NEAR LAS
TROJAS COMMUNITY**



Photo by B. Byers, September 2013

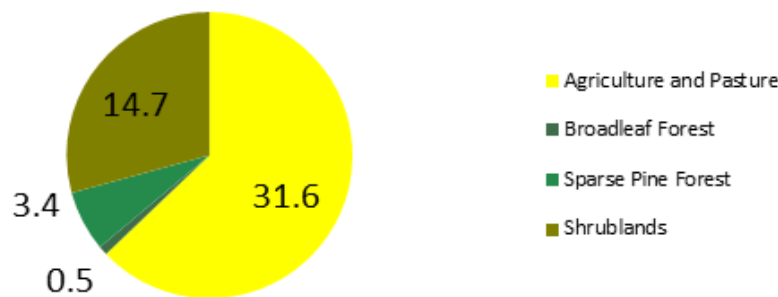
**UPPER WATERSHED OF THE RÍO TISCAGUA LOOKING TOWARD LA BOTIJA
PROTECTED AREA, WITH MAIZE AND BEAN FIELDS**



Photo by B. Byers, September 2013

LA FORTUNA COMMUNITY, MUNICIPALITY OF EL CORPUS

LAND COVER/USE FOR LA FORTUNA IN THE MUNICIPALITY OF EL CORPUS



The community of La Fortuna is located in the upper watershed area of the Río Sampile, about 15 km east of Choluteca. La Fortuna lies within the Cerro Guanacaure Multiple-Use Protected Area, which is nominally co-managed by *Comité para la Defensa y Desarrollo de la Flora y Fauna del Golfo de Fonseca* (CODDEFFAGOLF) with *El Instituto Nacional de Conservación y Desarrollo Forestal, Áreas Protegidas y Vida Silvestre* (ICF).

GOOGLE EARTH IMAGE OF THE CERRO GUANACAURE AREA; LA FORTUNA IS APPROXIMATELY IN THE CENTER OF THE IMAGE



About 1,500 people in 350 households live in the community. About half of all families here grow basic grains (maize and beans), but the entire community depends on this production to meet subsistence needs. The principle source of income here is fruit growing, and community leaders estimate that 50-70 percent of families engage in this activity. Nance is the main fruit produced in the area, but mango,

mamon, avocado, anonas, and oranges are also produced. According to community leaders, during the months of June, July, and August, families here earn around 60,000 to 70,000 Lempiras per day selling nance that goes to markets in Choluteca and other towns in the area. People do not process fruits here, but community leaders would like to develop fruit-processing enterprises in the area to increase employment and income. About 5–8 percent of families keep livestock of some kind – cattle, pigs, or chickens. Growing basic grains and fruits depends on adequate rainfall during the rainy season, and fruit and grain yields are poor during dry years. No one here uses drip irrigation yet.

About 10 percent of families grow crops such as cilantro and chile on their farms using irrigation, but this is a minor economic activity.

About 5 percent of people currently engage in artisanal gold mining in the area. During the dry season from November to April, people from this area travel to the commercial agricultural areas on the coastal plain to pick and pack melons or to cut sugarcane. About 10 percent of the adults work in the melon industry, 90 percent of whom are women; about 25 percent of men seasonally cut sugar cane to earn income. There are a few carpenters who use local wood to make furniture. Remittances from family members living overseas are not at all important here.

Water for the community comes from two streams starting on Cerro Guanacaure. From one a 4.5-inch diameter pipe carries water to a tank that supplies water 24 hours a day to 100 households. Those households pay 300 Lempiras per year for water, which is not enough to maintain the system if there are major problems with the infrastructure. Water quality is hardly ever monitored; the last time it was tested was two years ago. Sedimentation is a problem, and they worry about contamination by mercury used in artisanal gold mining. The community places a high value on the protection of forests that are the recharge zones for their domestic water supply. They have a protection committee and forest guards that watch out for the core zone of Cerro Guanacaure, but there is no compensation from ICF, CODDEFFAGOLF, or the municipality for those protection efforts.

CERRO GUANACAURE FROM NEAR LA FORTUNA



Photo by B. Byers, August 2013

**PIPES TAKE WATER FROM CERRO GUANACAURE, NEAR LA FORTUNA, TO
SUPPLY DRINKING WATER TO THE CITY OF CHOLOTECA**



Photo by B. Byers, August 2013

COMMUNITY WATER TANK, LA FORTUNA



Photo by B. Byers, August 2013

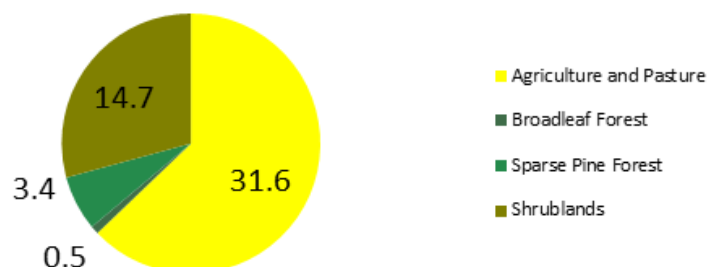
RECENTLY CLEARED PASTURE NEAR LA FORTUNA



Photo by B. Byers, August 2013

SAN JUAN ABAJO COMMUNITY, MUNICIPALITY OF EL CORPUS

LAND COVER/USE FOR SAN JUAN ABAJO COMMUNITY IN THE MUNICIPALITY OF EL CORPUS



San Juan Abajo is a community on the side of Cerro Guanacaure, on the road leading to the town of El Corpus. Like La Fortuna, it is within the Cerro Guanacaure Multiple Use Protected Area, in the upper watershed area of the Río Sampile. About 750 people in 150 households make up this community.

GOOGLE EARTH SCREENSHOT OF EL CORPUS SHOWING MANY TUNNELS OF ARTISANAL GOLD MINES IN ADDITION TO A LARGE COMMERCIAL CYANIDE LEACH-HEAP GOLD MINE IN VALLEY OF THE RÍO SAMPILÉ, CENTER RIGHT



The principal economic activity here is artisanal gold mining, with about 50 percent of the community working in mining. Men are employed in the tunnels, while women and children wash the gold in streams. About 25 percent of the population is employed in subsistence agriculture of maize and beans, and about 25 percent work seasonally in the commercial agricultural sector (melons and sugarcane). Growing fruits and okra are minor activities for some families. Livestock-keeping is also minor, and remittances are not important.

Domestic water comes from a spring above the community, from which a 1.5-inch pipe carries water to an 11,000-gallon tank. Water is available every other day for 24 hours, and households pay 300 Lempiras per year for water supply. One woman commented that “mining gives life to the economy here; but it is killing us, because we don’t have clean water in the streams to wash with.” Firewood comes from farms or the clearing of fields; it is scarce and expensive if purchased, costing 50 Lempiras per bundle.

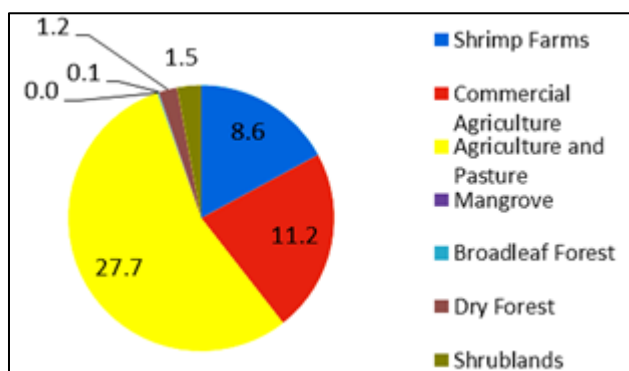
**WATER IN STREAM AT SAN JUAN ABAJO CONTAMINATED WITH SEDIMENTS
AND MERCURY FROM SMALL-SCALE GOLD MINES**



Photo by B. Byers, September 2013

GUAMERU AND COSTA AZUL COMMUNITIES IN THE MUNICIPALITY OF NAMASIGUE

LAND COVER/USE FOR GUAMERU AND COSTA AZUL COMMUNITIES IN THE MUNICIPALITY OF NAMASIGUE



The small fishing communities of Guameru and Costa Azul are about 25 km from Choluteca, near three of the coastal habitat/species management areas that are co-managed by CODDEFFAGOLF and ICF: El Jicarito, La Berberia, and Estero San Bernardo.

GOOGLE EARTH SCREENSHOT OF THE AREA AROUND GUAMERU COMMUNITY



About 365 people in 100 families live in these two communities. Fishing is the main economic activity here, with about 75 percent of adults involved in fishing. Marine products are basic to subsistence in these communities, and people have access to a seasonal lagoon (*laguna de invierno*) with an area of about 400 hectares where they catch shrimp and fish. This area has water and is productive only in the wet season; in the dry season, it dries out. Shrimp are sold to Granjas Marinas for export; fish are also sold and consumed. These communities do not have access to or depend on mangroves. An association of women from the communities has an 18-hectare shrimp pond. Commercial shrimp ponds occupy approximately 1,800 hectares in the area. Community members said that if fishing collapses here, they will have to move elsewhere. An evaluation of fishing in the Gulf of Fonseca conducted in 2012 by

Cooperación Española, *Secretaría de Agricultura y Ganadería (SAG)*, and *Mancomunidad de Municipios del Sur (NASMAR)* showed that the number of fishermen had declined by about 20 percent between 2004 and 2009. (AECID, 2012).

Another 10 percent of residents (mostly young people) in this area work as laborers in the commercial shrimp, melon, and sugar industries. About 10 percent are farmers, producing mainly maize and cowpeas (*Vigna unguiculata*, frijol alacín) on land rented from large landowners. About 5 percent keep livestock. The average family has about one-third to 1.75 hectares of land and grows yuca, camote, and occasionally fruits (e.g., nance, mango, cashews, oranges, and lemons).

Wood for cooking and building is obtained from the mountains. Remittances are not important here.

Working with CODDEFFAGOLF and the Municipality of Namasigue, Cooperación Española, the Spanish national aid agency, has helped the community to develop the collection center where fishermen can bring what they catch. This setup provides them with better access to markets.

ESTUARY NEAR GUAMERU COMMUNITY



Photo by B. Byers, August 2013

**BOY FISHING FOR SHRIMP WITH A CAST NET BELOW OUTFLOW CHANNEL OF A
COMMERCIAL SHRIMP POND**



Photo by B. Byers, August 2013

**TRUCK STUCK IN FLOODED RÍO SAMPIL, BELOW SAN JUAN ABAJO
COMMUNITY, AFTER A HEAVY RAIN**



Photo by B. Byers, September 2013

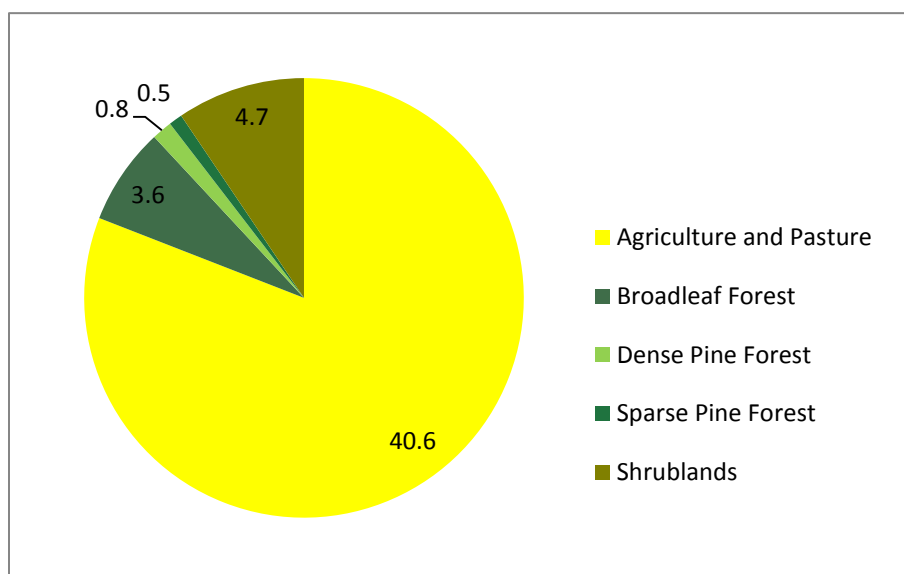
**GREAT EGRETS IN THE LA BERBERIA HABITAT/SPECIES MANAGEMENT AREA
NEAR GUAMERU COMMUNITY; CERRO GUANACAURE IS IN THE BACKGROUND**



Photo by B. Byers, August 2013

SANTA ANA DE YUSGUARE CITY AND MUNICIPALITY

LAND COVER/USE FOR SANTA ANA DE YUSGUARE



The Municipality of Santa Ana de Yusguare, with a population of about 14,600, occupies about 72 km² below Cerro Guanacaure in the valley of the Río Sampile, about 10 km from the city of Choluteca. The municipality is supposed to be directly responsible for management of 430 hectares of the total of 1,760 hectares in the Multiple-Use Protected Area.

GOOGLE EARTH IMAGE OF THE SANTA ANA DE YUSGUARE AREA; COMMERCIAL MELON FIELDS CAN BE SEEN EAST OF THE CITY



The local economy here is based on agriculture. About 80 percent of the population grows basic grains for subsistence, and 60 percent has livestock. Eighty percent of the population is involved in fruit-growing (mango, nance), and about 10-20 percent is involved in horticulture for sales to regional markets. Approximately 1,000 hectares are leased by commercial agro industries to grow sugarcane, melons, and okra. Those industries pay approximately 60,000 Lempiras per month in rent to the municipality, its largest source of revenue. Between 10 and 20 percent of the population is employed in season by these agro industries as laborers; okra alone generates about 1,000 seasonal jobs. Because it is so close to Choluteca, this area's economy is closely linked to that of the departmental capital; many people travel there and to the nearby area for work.

Brickmaking is also an important economic activity here; according to local leaders, brickmaking involves 5-10 percent of the population. Wood-fired brick kilns require a lot of firewood. Beekeeping and micro-industries can be found here, and some women make mango jams and jellies. Various projects are working on value-chain development here, including CARE *Promoción de la Seguridad Alimentaria y Desarrollo Económico en las Cuencas de los ríos Choluteca y Negro* (PROSADE) and Emprendesur.

Water here comes from Cerro Guanacaure. Of the domestic water supply, 40 percent comes from streams from Cerro Guanacaure, and 60 percent comes from wells that also tap groundwater coming from the mountain. Sixty percent of the population has access to piped drinking water. Because wells (which require energy for pumping) provide the majority of the water, people pay a water tariff of 75 Lempiras per month for water.

Water for irrigation comes from rivers and from groundwater. About 25 percent of the agricultural land here is irrigated, especially that for commercial production. Melons are grown with plastic covering the soil and through the use of drip irrigation and pesticides.

**COMMERCIAL MELON FIELDS NEAR SANTA ANA DE YUSGUARE PREPARED AND
READY TO BE PLANTED, WITH CERRO GUANACAURE IN BACKGROUND**



Photo by B. Byers, September 2013

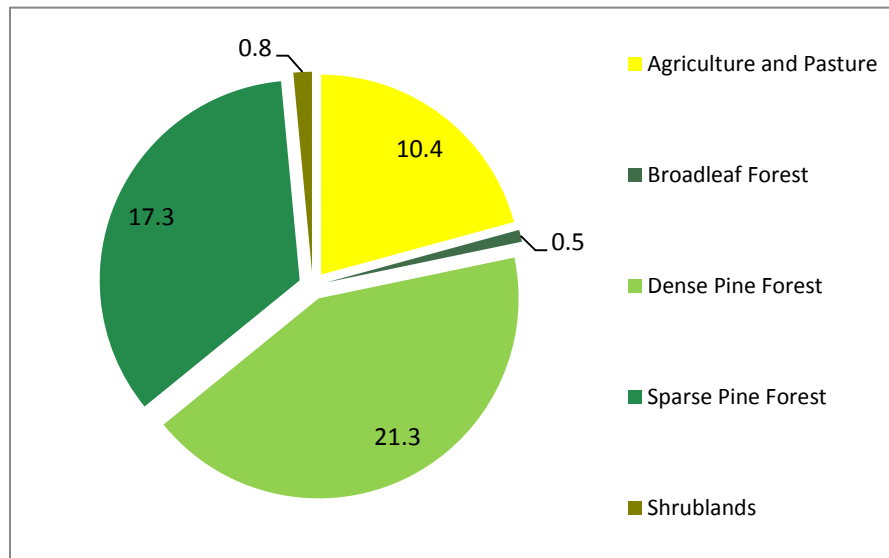
**FLOODED COMMERCIAL MELON FIELDS AFTER A HEAVY RAIN A FEW DAYS
PRIOR**



Photo by B. Byers, September 2013

SAN JUAN DE DUYUSUPO AND EL JOCOTE COMMUNITIES, MUNICIPALITY OF SAN MARCOS DE COLON

LAND COVER/USE FOR SAN JUAN DE DUYUSUPO AND EL JOCOTE COMMUNITIES IN THE MUNICIPALITY OF SAN MARCOS DE COLON



These small rural communities are about 20 km south of San Marcos de Colon, within the Montaña La Botija Multiple-Use Protected Area. The protected area is co-managed by the Municipality of San Marcos de Colon along with ICF, which is responsible for all protected areas from the national government level. Natural ecosystems here are mainly pine and mixed pine-oak forests of varying density, most with significant grass understory; thus, they can be called pine or pine-oak savanna ecosystems. A small area of cloud forest is found here at the highest elevations. The mountains of La Botija form the upper watersheds of the Río Coco, flowing north to the Atlantic, and the Río Negro, flowing into the Gulf of Fonseca. The Río Negro forms the border with Nicaragua in much of its course, and Honduras and Nicaragua share its watershed.

GOOGLE EARTH SCREENSHOT SHOWING APPROXIMATE LOCATION OF THE COMMUNITY OF SAN JUAN DUYUSUPO



In this area, there are about 2,000 rural households. Approximately 10,000 people live here. The main livelihoods in the area are livestock-raising, production of basic grains, and coffee production. According to key community informants, about 80 percent of the area is forested, and 20 percent is cleared for crops. Livestock production forms the basis of the local economy, with 40 percent of households having from a few to up to 30 cattle. There is a surplus of production that is sold to local markets and provides income for the area. Cattle graze in the natural pine and pine-oak savanna habitats, so this is a silvi-pastoral system. Production of basic grains (maize and beans) only occurs for household consumption; about 40 percent of the population grows these subsistence crops.

Coffee production is possible at the elevations found here, and over 600 hectares of coffee are now grown under shade in pine-oak forests. This economic sector is now very important according to community informants, and approximately 20 percent of the population depends on income from coffee. Production is expanding, with plans for about 50 more hectares now in nurseries. The local coffee producers' cooperative (COCASAN) has approximately 600 members. Some families in El Jocote also grow fruits and produce horticultural products (tomatoes, chile, and onions), with some even using drip irrigation and plastic covers to conserve water. These activities are of minor importance to the overall incomes of the area, but they are important to some families. A small amount of artisanal gold mining is also beginning in the area, with five tunnels at El Zarzal. Very few people here (only 1 or 2 percent of families) receive remittances from relatives living in the United States or elsewhere; thus, remittances are not important to the local economy.

Community informants had the perception that there was less fog now than in the past, and that thunderstorms had become more intense. They described a recent thunderstorm event that produced severe hail, which damaged crops in the area. Under the predicted climate scenario of warmer temperatures and less precipitation in the south of Honduras, the "climate envelope" for natural vegetation will shift, creating an effect similar to a decrease in elevation in the current climate. Under

that scenario, the most threatened ecosystem would be cloud forest, which may disappear entirely as increasing temperatures cause the cloud base to rise. Warming and drying may also cause a thinning of the pine and pine-oak savanna and may increase the fire frequency in the area. These natural ecosystems are somewhat fire-adapted; ocote pine, *Pinus oocarpa*, shows a number of fire-adapted traits such as semi-serotinous cones, fire-resistant bark, and a self-pruning growth form. Local people consider fire to be the most important threat here, mainly because it can destroy coffee plantations. Warmer, drier conditions in general would make coffee cultivation here more difficult, because coffee is growing at almost the lowest possible altitude in the current climate here. Such a climate shift also would potentially reduce the growing season for maize and beans and potentially reduce production. Additionally, growth of grasses eaten by livestock may be reduced under these conditions. Irrigated fruit and vegetable crops, especially those using water-conserving methods of irrigation, may not be affected significantly. Tree crops (fruits) could tap deeper sources of soil moisture and also therefore be less affected by a warmer, drier climate.

**LOOKING TOWARD THE CORE OF THE LA BOTIJA PROTECTED AREA FROM A
CATTLE FARM NEAR SAN JUAN DE DUYUSUPO**



Photo by B. Byers, September 2013

**LOOKING DOWN THE UPPER VALLEY OF THE RÍO NEGRO FROM LA BOTIJA
PROTECTED AREA NEAR SAN JUAN DE DUYUSUPO**



Photo by B. Byers, September 2013

DENSE PINE FOREST WITH PASTURE NEAR SAN JUAN DE DUYUSUPO



Photo by B. Byers, September 2013

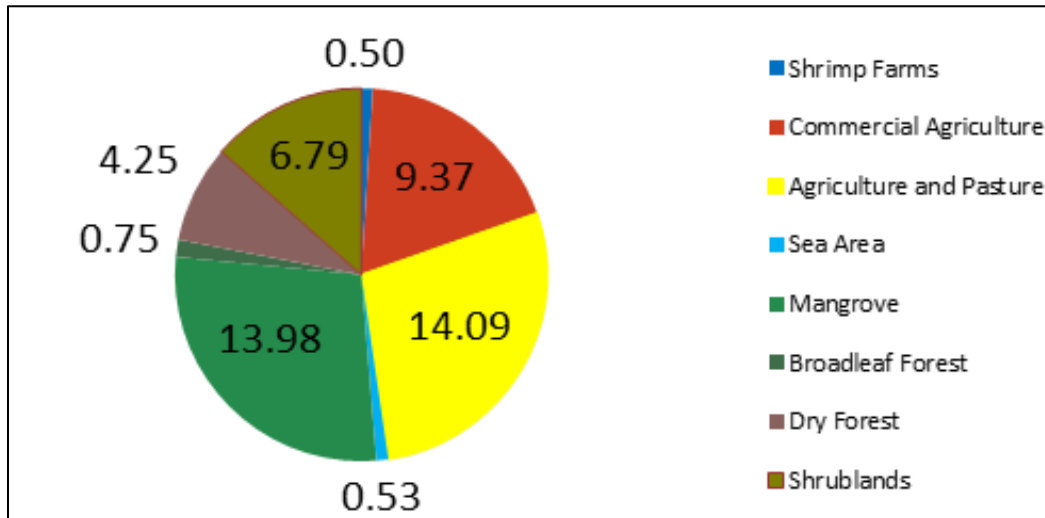
**COFFEE PLANTED UNDER SHADE OF NATURAL PINE-OAK FOREST NEAR SAN
JUAN DE DUYUSUPO**



Photo by B. Byers, September 2013

AGUA FRIA AND LA BREA COMMUNITIES, MUNICIPALITY OF NACAOME, DEPARTMENT OF VALLE

LAND COVER/USE FOR AGUA FRIA AND LA BREA



These two neighboring communities are approximately 10 km west of Nacaome. La Brea is within the Bahía de Chimucho Habitat/Species Management protected area, a Multiple-Use Protected Area co-managed by CODDEFFAGOLF and ICF.

GOOGLE EARTH SCREENSHOT OF AGUA FRIA AND LA BREA, WITH BAHIA DE CHISMUYO MANGROVES ON LEFT SIDE



In Agua Fria, there are around 6,000 inhabitants in 1,100 houses; La Brea is a smaller community with about 675 people and 115 houses. The economy of these communities depends on a mixture of fishing and agriculture. Fishing generates the most employment and is characterized in two ways: fishing from boats as well as the on-foot collection of crabs, curiles, and casco de burro in the mangroves. Middlemen (coyotes) directly buy fish from the fishermen to sell in the regional market; they export casco de burro to El Salvador. In some cases women from fishing families directly sell fish in neighboring communities. Some fishermen salt and dry fish to sell for Holy Week (semana santa). When fishing is not good, some fishermen work as laborers in commercial agriculture (melon and sugarcane). Some fishermen grow maize here also. In November, some people search for and harvest wild honey in the mangroves.

About 40 percent of the families in Agua Fria grow maize, and about 10 percent have livestock. From October to May, some people are employed as laborers in commercial agro-industries (melon, watermelon, sugarcane, and sesame). There are about 80 hectares of salt-making ponds in the area; these operate in the dry season, from November to March. A small ecotourism company offers mangrove tours and prepared meals for groups at an environmental education pavilion in the mangroves, but this enterprise has not really taken off nor has it attracted much business.

About 60 percent of families in Agua Fria and about 80 percent of families in La Brea receive remittances from relatives living elsewhere. In recent years, there has been a lot of migration to the United States from the area, as well as some to Spain.

The mangroves provide wood for building houses and cooking. Some are harvested for tanning hides; much of this work is carried out by Salvadorans. Salvadorans illegally exploit all of the ecological resources of the Bahía de Chismuyo Habitat/Species Management Area, but there is no regulation or control by Honduran authorities.

There is one Junta de Agua that covers both Agua Fria and La Brea. Water comes from a spring, probably flowing from Cerro el Chagüite near Nacaome. A four-inch and a six-inch pipe distribute this water to approximately 600 households, which have water for four hours per day and pay 100 Lempiras per month for this service. The system is 23 years old and is collapsing; fees are not sufficient to cover maintenance costs. Community leaders say there has been a decrease in the flow of water from the spring in the past few years.

**LA BREA EMBARKATION POINT FOR THE BAHIA DE CHISMUYO HABITAT/SPECIES
MANAGEMENT AREA**



Photo by B. Byers, August 2013

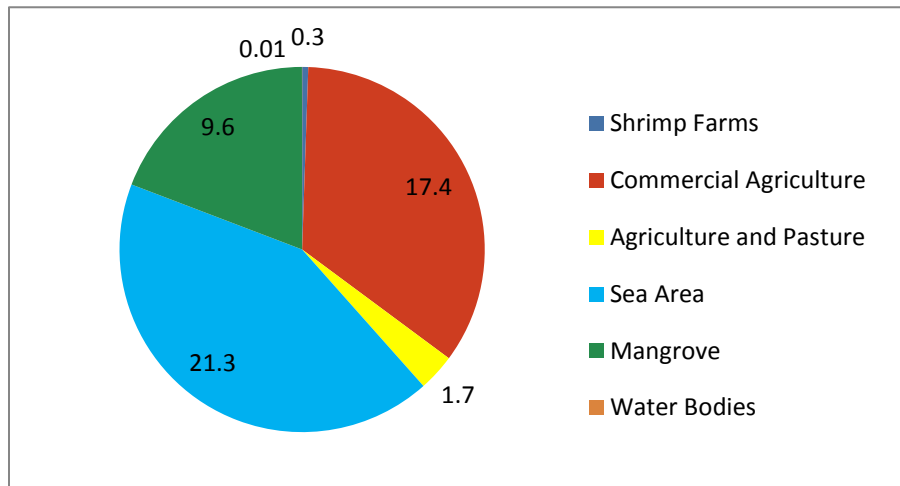
FISHING BOATS AT LOW TIDE, LA BREA



Photo by B. Byers, August 2013

CEDEÑO, EL EDEN, AND BOCA DEL RÍO VIEJO COMMUNITIES, MUNICIPALITY OF MARCOVIA

LAND COVER/USE FOR CEDEÑO, EL EDEN, AND BOCA DEL RIO VIEJO



These coastal fishing communities are about 20 km west of Marcovia, facing the Golfo de Fonseca. These communities are within the Los Delgaditos Habitat/Species Management Area, one of the 11 protected areas in southern Honduras. This protected area is co-managed by CODDEFFAGOLF with ICF. The natural ecosystems found in this area are mangroves, beaches, and the open water of the Golfo de Fonseca. Marcovia municipality, in which these communities are located, lies between the deltas of the Río Nacaome to the north and Río Choluteca to the south, which significantly influences the hydrology of the mangroves and Gulf in this area. The underground aquifer of the area is also strongly influenced by fresh water flows from five micro-watersheds arising in the hills of the coastal plane to the east – those of the Simisiran, Caucara, Laure, La Castaña, and Agua Caliente Rivers. Flow from these watersheds and the nearby major rivers helps to push underground saline water deeper and to hold back its intrusion into the aquifer. For their domestic water supply, people here depend on wells that tap the shallow subsurface aquifer.

GOOGLE EARTH SCREENSHOT OF BEACH AT EL EDEN; NOTE MANGROVES BEHIND BEACH AND SHRIMP PONDS AND THEN SUGARCANE GOING INLAND.



About 9,000 people in approximately 1,500 households live in these communities. People here depend almost entirely on fishing for income, with which they buy maize and beans for food. They do not own agricultural land and do not grow basic grains here. Fishing is characterized in two ways: fishing from boats and fishing on foot. There are two types of fishers from boats, those who specialize in catching fish or in catching shrimp. The main fish caught are babosa, a type of corvina, and small fish such as pirracha. Fishermen can catch between 20 and 25 pounds of fish per day, or between three and five pounds of shrimp per day. The price for babosa is now around 17 Lempiras per pound; for shrimp it is around 85 Lempiras per pound. Curiles are mainly gathered by women and children wading in the mangroves at low tide and picking them from the roots of red mangroves. Curiles sell for about 70 Lempiras for 100 units. Mangrove crabs, punche, are also harvested by women and children wading in the mangroves. Curiles are sold mainly to tourists, who don't come to the area in the rainy seasons; income for women and children declines at that time. Fishermen using boats have to use some of their income to buy fuel; depending on the size of outboard motor, fuel can cost between 200 and 500 Lempiras per day. On some days, this amount is as much as the value of the fish caught and sold, so there is not much money left to buy basic grains and other needs.

No one here works as a laborer on melon or sugarcane farms. Remittances are not at all important in the local economy of these communities. Beach restaurants are a source of employment and income during the tourist season, which draws Honduran tourists from Choluteca and elsewhere. According to community members here, economic opportunities are very limited; they live from “marea a marea” – from tide to tide. They believe that fishing communities in other areas such as Agua Fria and La Brea have more diverse economic opportunities.

The extensive mangroves that used to exist here have been, and are being, gradually converted to sugarcane fields farther from the coast, and to shrimp ponds closer to the coast. Local people perceive that this loss of mangroves has reduced fish and shellfish numbers, and thus harmed their livelihoods. Every year during the rainy season, this coastal area is flooded.

People depend mainly on well water, but over the years this source of fresh water has become threatened; now, as far inland as Monjarás, even shallow wells between 2 and 4 meters deep reach saline water. Some water is piped via San Isidro, but it comes from a well near the Pantaleon sugar mill and fields, and people believe the water is contaminated especially with urea from fertilizer use on commercial crops. Some people who were assisted by a project conducted by Engineers Without Borders are using filtered rainwater.

Beach erosion at Cedeño has been dramatic during the past decade, with approximately five blocks of expensive beach houses and restaurants collapsing into the sea as the beach receded. In places where mangroves are found behind beaches, such as at El Eden, the coastal recession and beach erosion has been held in check as compared to Cedeño. Satellite-based measurements of sea level in the Gulf of Fonseca do not show any sea-level rise during this period of time, so this beach erosion seems to be due to other factors – perhaps changes in sedimentation rates from certain rivers or changes in mangrove hydrology and functioning around the gulf. If the sea level does begin to rise when the ENSO cycle next enters a warm phase, beach recession and saltwater intrusion may accelerate dramatically.

These fishermen believe that warmer, drier climatic conditions will cause fish to move, probably farther offshore as they seek cooler and less saline oceanic water, and perhaps even outside the mouth of the Gulf, where Nicaragua and El Salvador do not permit Honduran fishermen to fish. They perceive that droughts reduce the reproduction of curiles, because salinity increases in the mangrove. A change toward a warmer, drier climate would have a similar effect.

RED MANGROVES AT MID-TIDE



Photo by B. Byers, September 2013

CURILES FOR SALE IN SAN LORENZO MARKET



Photo by B. Byers, September 2013

GIRL SELLING PUNCHES, MANGROVE CRABS, NEAR MONJARÁS



Photo by B. Byers, September 2013

OLD FISHERMAN MENDING NETS, CEDEÑO



Photo by B. Byers, September 2013

BEACH RESTAURANT, EL EDEN



Photo by B. Byers, September 2013

ANNEX F. INTERVIEW WITH MELON INDUSTRY REPRESENTATIVE

FIELD VISIT TO AGRO-INDUSTRY SECTOR

DECEMBER 5, 2013

General data

Company name: Agrolibano (melon producers) of Montelibano Farm

Location: Municipality of Namasigue

Watershed: Namasigue/Quebrada Seca River

Protected Area: Cerro Guanacaure

Interview with: Ing. Antonio Oviedo, Farm Manager

Email: anotniooviedo@agrolibano.com; **Phone:** (504) 9483-0360

I. What is the perceived threat of climate change to the melon industry?

In answer to this question Mr. Oviedo said, “Climate change affects the whole operation of the industry because we depend on water for it”. He stated that during the past five years, the farm and region have faced high rainfall variability. According to company records, during the past eight years rainfall ranged from 2500 mm/year to 3000 mm/year. Rainfall amounts have been so erratic that ranges go from a minimum of 1675 mm in 2012 to a maximum of 3360 mm in 2010 (Table I).

TABLE I. ANNUAL PRECIPITATION AMOUNTS AND CANICULA TIME VARIABILITY IN THE FINCA MONTELIBANO

Year	Annual mean precipitation (mm.)	Precipitation (mm) During canicula months (15 July to 15 August) (mm.)	Higher precipitation months (Sept- Oct) (mm.)
2008	2400	231	308
2009	1916	82	196
2010	3360	404	8
2011	3100	659	927
2012	1675	0	80
2013	1831	95	360

Source: Ing. Antonio Oviedo, farm manager, Finca Monetelibano

Agrolibano Farm currently produces 560 ha of melons under drip irrigation. Water sources are three drilled wells with an average water production of 250-300 m³/hour. In order to increase the water supply during the dry season, they build four ponds with a total area of 35 hectares to store water, with a storage capacity of 1,200,000 m³. Some of that water (30 percent) is lost through evaporation, and they also release between 250,000-300,000 m³ (25-30 percent) for downstream water users, usually cattle farmers. In general, approximately 1.5 million m³/year of water is diverted from the Rio Namasigue or Quebrada Seca (Figure 1).

FIGURE 1. NAMASIGUE RIVER (LEFT) MELON PLANTATION IN AGROLIBANO FARM (CENTER) AND INTERVIEW WITH ING. OVIEDO, NAMASIGUE, CHOLUTECA, HONDURAS



Melon crop water demand in this area is approximately 2,860 m³/ha/175-day crop-cycle. This demand is equivalent to 1.6 million m³/560 ha/crop-cycle, for an overall water use of 3.2 million m³ of water per year. According to the team's analysis, if this melon company joined an agreement to create a Payment for Ecosystem Services scheme for the Quebrada Seca watershed and paid 0.10 Lempiras per m³ of water, it would create a fund of approximately 320,000 Lempiras (about \$16,000) per year.

This company invested 2.5 million Lempiras to construct the 35 hectares of water-storage ponds. They also spend 1.2 million Lempiras per year to build retention structures along the river bed and 150,000 Lempiras per year in maintenance costs for those retention structures. The extraction cost of river

water is a third of the cost of well pumping, indicating the importance of watershed protection to increase water retention, groundwater recharge, and water quality. However, river water had to be treated with chlorine before being used for drip irrigation because it did not meet the melon export industry standard for sanitary quality.

According to Mr. Oviedo, the cost of melon production is \$15,700/Ha (322,000 Lempiras/Ha), 20 percent of which covers the cost of water management – in other words, about \$3,140.00/Ha (64,500 Lempiras/Ha/two-crop production cycle). This enterprise exports 50 percent of its melon production to the United States and 50 percent to the European market. It produces 35.7 TM/Ha, equal to 1.4 container/Ha. In the short term, they also plan to export to the Japanese market.

2. What are their current activities and future plans for responding to current climate variability and projected climate change?

Mr. Oviedo stated that, due to the increased water cost, they are trying to improve water efficiency. To achieve this goal, they plan to transition to protected agriculture and start 285 hectares of hydroponic production. According to his data, a 70-Ha hydroponic greenhouse might produce the equivalent to that of 270 hectares of open land.

This company uses weather stations and manual rain gauges to accurately measure precipitation. They collect plant tissue every two days to evaluate plant water stress and nutritional content. They also have installed soil moisture sensors. All of this work is done to apply just enough water to meet crop water demand according to phenology and evapotranspiration.

This company assesses daily water supply in the river using an area-velocity method that is very labor intensive and less accurate; thus, they expressed interest in training and technical assistance in automatic stream flow measurement methods if a program or project becomes available in the future.

Interestingly, they already have an outreach program to promote reforestation in nearby communities, to build eco-stoves to reduce fuel wood consumption, and to minimize deforestation. They also have planted trees on their land and set aside more land for reforestation.

3. What is their willingness to develop and to engage in public-private partnerships to assist communities and municipalities in Choluteca and Valle to prepare for/adapt to climate variability and change through extension programs or through compensation or payments for ecosystem services?

Mr. Oviedo expressed that the company recognizes their strong dependency on water for a sustainable business. He also said that, knowing the climate variability during the past eight years, doing isolated reforestation activities will not work or will have little return for the bottom line, which is “seeing more water flowing in the river.”

They are very interested in joining a watershed-wide stakeholder’s organization to implement an integrated watershed and water management plan. They know that “the sustainability of the enterprise depends on a healthy watershed that provides a clean and steady water supply.”

Mr. Oviedo stated that it is not sustainable to invest approximately \$58,536 (1,200,000 Lempiras) per year — amounting to 14.4 million Lempiras in the past 12 years — to build and maintain water detention structures.

Following this interview, the team believes that establishing a *Pagos por Servicios Ambientales* (PSA) mechanism for the Rio Namasigue watershed and Cerro Guanacaure protected area is feasible. It could potentially attract financial support from Agrolibano, Azucarena Choluteca, and cattle farmers in the lower watershed, as well as link them with community groups in the upper catchment.

ANNEX G. INTERVIEW WITH SUGAR INDUSTRY REPRESENTATIVE

FIELD VISIT TO THE AGRO-INDUSTRY SECTOR

DECEMBER 5, 2013

General data

Company name: Azucarera Choluteca

Location: Municipality of Marcovia

Watershed: Lower Choluteca River

Protected Area nearby: Bahía de Chismuyo y Los Delgaditos

Interview with: Ing. Sergio Salina, Assistant Manager, Azucarera Choluteca, S.A. de C.V Ing.

Email: ssalinas @cahsa.hn; **Phone:** (504) 9995-3921; (504) 2782-0530

I. What is your perception of the threat of climate change to the sugar industry?

In response to this question, Ing. Salina said that, “In the past few years, we have faced very high climate variability, which drastically affected the sugarcane crop, making this industry very vulnerable to climate change.”

Sugarcane has an annual water demand of approximately 1500 mm. A decrease in rainfall affects production, since sugarcane is an annual crop. Azucarera Choluteca, for example, used to produce 115-129 Ton/Ha under normal rainfall conditions; at present, production has gone down to an average of 93 Ton/Ha. In past years, they have not considered climate variability for the expansion of the cultivated land. At present, they cultivate 6,293 Ha. Of this total area, 70 percent belongs to Azucarera Choluteca, and 30 percent belongs to independent producers. Of this total (6,293 Ha), 4,720 Ha are under irrigation and 1,573 Ha are rain-fed crops.

According to the production records, they produce 210 pounds of sugar per ton of cane. They sell unrefined (brown) sugar in the U.S. commodity market at an average of \$0.18/pound. In the Honduran national market, they sell refined sugar at an average price of \$0.30/pound. According to this information from the sugar cane producers, they generate \$18.6 million from exports and more than \$13.6 million from sales in the national market. The company has 400 permanent employees and 1,000 seasonal jobs, making it an important employer in the south.

**FIGURE 2. SUGARCANE HARVESTING (LEFT) MACHINERY CANE PICK (CENTER),
INTERVIEW WITH ING. SERGIO SALINA, MARCOVIA, CHOLUTECA.**



2. What are their current activities and future plans for responding to current climate variability and projected climate change?

In the country and probably in Central America, this company is among the ones that have invested the most in water. However, most of its irrigation systems are still very inefficient, with 18 percent gravity-supplied water, 80 percent sprinkler irrigation (pumped water), and only 2 percent drip irrigation. Due to the lack of water, they plan to increase the area under drip irrigation in the near future.

In the 1990s, the company depended mostly on water extraction from the Choluteca River. Due to the high river sedimentation that occurred during Hurricane Mitch in 1998, the company started drilling wells and built water-harvesting ponds.

**FIGURE 3. GROUND WATER PUMPING STATION (LEFT), SUGARCANE TRANSPORT
IN AZUCARERA, CHOLUTECA, MARCOVIA (RIGHT)**



Due to the decrease of water production and the increasing cost of pumping, the company installed monitoring wells to track changes in the water table. This action is similar to that of other companies, but they all work in isolation to meet their self-interests.

More recently, this company increased its sugar processing capacity from 4,500 TM/day to 6,000 TM/day. This extra processing capacity is pushing them to increase the cultivated area up to 8,392 Ha, and water availability is a concern.

3. Is there any willingness to develop and engage in public-private partnerships to assist communities and municipalities in Choluteca and Valle to prepare for/adapt to climate variability and change through extension programs or compensation or payments for ecosystem services?

The company is member of *Fundacion de empresas Azucarera* (FUNDAZUCAR). They have a program called the Sweet and Green project to promote reforestation and environmental conservation. As part of this initiative, they produce 100,000 nursery plants per year, of which 6,000 are planted within the company land. They bought hills around the sugar farms and planted 490 Ha of timber-producing trees.

This area is being put under protection to maintain water recharge. The most commonly planted timber trees are arecarreto, guanacaste, and laurel. They also produce fruit trees (jocote, yuyuga, tamarindo, nance, and marañon) and give them to local farmers. These reforestation activities are coordinated with the municipalities of Namasigue and Marcovia.

The Sweet and Green project costs them an average of \$24,400/year (500,000 Lempiras/year). They think that promoting forest planting as a business could be a good strategy to restore permanent land cover in key priority areas.

In conclusion, when the team asked about their willingness to participate in environmental protection of the watershed where they obtain water, they said, “Yes, we are already investing in environmental protection. We just need to reorient financial resources and select priority areas within catchments.” They expressed interest specifically in the Rio Namasigue/Quebrada Seca, where they grow around 1,000 Ha of sugarcane with limited water supply. This watershed is among the most stressed water supply areas due to increased water competition between melon and sugarcane growers, as well as cattle farmers. This area lacks an exploitable ground water aquifer.

Ing. Salina still does not believe that climate change is happening, but he understands that the variability of rainfall affects water supply, which in turn affects the industry. He believes that the company would participate in a watershed initiative to promote permanent land cover restoration and protection.

ANNEX H. PAST EXPERIENCE RELEVANT TO CLIMATE CHANGE ADAPTATION AND BIODIVERSITY CONSERVATION OF SELECTED PROJECTS AND ORGANIZATIONS

Action for Climate Change Adaptation	Project or Organization	Specific Relevant Experience
I.1 Conduct a study to establish baseline information on the eco-hydrology of targeted watersheds (e.g., Río Negro, Sampile, Nacaome)	<i>Escuela Agrícola Panamericana (EAP)-Zamorano</i>	Dr. Luis Caballero conducted eco-hydrology studies in the La Tigra protected area and the Capiro Zapotillo micro watershed for academic purposes and as pilot projects.
I.2 Conduct a study to establish baseline information on the eco-hydrological functioning of mangroves and their effects on flows of water in the Gulf, water quality and salinity, saline intrusion in coastal aquifers, etc.	Honduran Aquaculture Association (ANDAH)-Ministry of Agriculture and Livestock (SAG) Water Quality Laboratory (<i>Laboratorio de calidad de agua</i>) <i>Programa Ambiental Regional para Centroamérica (PROARCA)</i> Agricultural Policies and Markets (APM)-National Oceanic and Atmospheric Administration (NOAA)-U. S. Department of Commerce (DOC)	The group has 15 years of historical water quality analysis from estuaries. Some efforts were undertaken in the context of the Hurricane (Mitch) Reconstruction Program. Many of NOAA's National Ocean Service (NOS) activities supported sustainable uses of the Gulf of Fonseca resources. NOAA's work involved developing a better understanding of the natural processes in the Gulf to support more sustainable uses by industry and for subsistence. The following projects contribute to an understanding of the Gulf of Fonseca ecosystems and improve management of coastal natural resources in the area: (i) completion of a baseline survey on the extent and distribution of contaminants in the Gulf of Fonseca, its estuaries, and surrounding areas; (ii) completion of a study of water circulation patterns in the Gulf of Fonseca; (iii) development of products that

		<p>improve the management of protected areas in the Gulf of Fonseca; and (iv) development of extension services for the shrimp aquaculture sectors in Honduras and Nicaragua.</p> <p>For more information, please visit this website: http://pdf.usaid.gov/pdf_docs/PDACL302.pdf</p>
I.3 Develop incentives to stop clearing of forest on steep slopes for basic grains production	<i>Proyecto Manejo Recursos Naturales (PRNM)</i>	This project focused on nursery plants for reforestation, forest management, and soil and water conservation structures at the small stakeholder farm level.
	<p>Lempira Sur</p> <p><i>Amigos de la tierra</i></p> <p><i>Asociación Nacional Para el Fomento de la Agricultura Ecológica en Honduras (ANAFAE)</i></p> <p><i>Centro Internacional de Información sobre Cultivos de Cobertura (CIDICCO)</i></p> <p>CARITAS</p>	This group focused on water management, sustainable agriculture, and land cover reforestation through an agroforestry system called Quezuntgualt.
I.4 Restore forests on steep slopes that have been cleared for basic grains production or pasture using native tree species	<p>PRNM</p> <p>PMA CP3</p> <p><i>Visión Mundial</i></p>	<p>This work was done in the Guanacaure protected area, micro-watershed recharge zones, and communal areas.</p> <p>They also focused on food for work to implement land restoration actions such as reforestation, planting nurseries, etc.</p>
I.5 Implement on-farm and municipal actions that increase water retention and infiltration (e.g., ponds, sand dams, contour strips, increased permanent ground cover)	<p>USAID/Land Use and Productivity Enhancement (LUPE)</p> <p>Watershed Management in Rio Negro, Rio Choluteca, Zamorano, USAID</p> <p>CARE PROSADE</p> <p>USAID/<i>Manejo Integrado de Recursos Ambientales (MIRA)</i></p> <p>Oxfam Quebec</p> <p>Ayuda en Acción/Acción Sur</p>	At the small hillside stakeholders' level, the project implemented a structure to protect and conserve soil and water; at the municipal level, it worked in the recharge zone of micro-watersheds, increasing and protecting permanent ground cover.
I.6 Implement on-farm soil and water conservation techniques to decrease runoff and soil erosion	<p>USAID LUPE</p> <p><i>Ayuda en Acción/Acción Sur</i></p> <p>Lempira Sur/United Nations Food and Agriculture Organization (FAO)</p> <p>CARITAS</p>	<p>Agronomical and mechanical conservation techniques were implemented at the farm level. Some of the most adapted techniques are: avoiding land burning, contour planting, mulch, rocks/live barriers, agroforestry, and silvopastoral systems.</p>

	ANAFAE Zamorano	
I.7 Protect/maintain/restore stream bank vegetation	CODDEFFAGOLF USAID Zamorano	They focus on restoration of riverbanks with rip-rap rock and woody trees to protect road access and the electric transmission line.
I.8 Promote a shift from basic grains to agroforestry systems (e.g., fruits, coffee)	USAID LUPE CARE PROSADE Oxfam Quebec <i>Ayuda en Acción/Acción Sur</i> Lempira Sur/FAO La Fundación Hondureña de Investigación Agrícola (FHIA) Upper Watershed Vegetation Restoration Initiative USAID Zamorano <i>Asociación de Productores de Café de Honduras (APROCAFEH), Instituto Hondureño del Café (IHCAFE)</i> <i>Proyecto de Competitividad Rural (COMRURAL)</i> Fundación Jicatuyo	These projects have promoted coffee and wood-producing trees in areas dedicated to annual crops (maize and beans), leading to permanent land-cover restoration. After 12 years, the coffee area is expanding throughout the watershed. They have also focused on: <ul style="list-style-type: none"> • implementing agroforestry systems with native forestry, such as Laurel with maize and sorghum; • implementing watershed recharge zone restoration with coffee and wood tree in the upper Yeguaré River Watershed; • providing financial aid and some technical assistance; • financing coffee projects through service providers (NGOs, consultants, etc.); and • working with high quality coffee producers in the western region, providing financial and technical assistance.
I.9 Control commercial and artisanal gold mining (El Corpus municipality) to prevent mercury and cyanide contamination of domestic water supplies, commercial crops, and shrimp.	None	By law, Secretaría de Recursos Naturales y Ambiente (SERNA)/Departamento de Minas e Hidrocarburos should be controlling and monitoring commercial and artisanal gold mining; however, according to local and municipal perception, this work is not demonstrated in the field.
I.10 Reduce groundwater pumping to prevent salt water intrusion and salinization of coastal aquifer	None	By law, SERNA/Departamento de Recursos Hídricos should be controlling and monitoring groundwater pumping; however, this work is not implemented in the field according to local and municipal informants.
I.11 Protect currently forested hills within the coastal plain as groundwater recharge zones through management agreements, change in legal status, etc.	Azucarera Choluteca	The manager says that they purchased hills to protect as water recharge areas; they have a large nursery program that produces 100,000 seedlings per year. Some are being planted on “hills” on company land.

I.12 Remove or redesign infrastructure of commercial shrimp ponds that block the escape of freshwater to the Gulf and/or prevent filling of seasonal freshwater lagoons	PROARCA/COSTAS PROARCA-APM	Some of the results from the historical process of construction of the Gulf of Fonseca Biological Corridor in the 1990s included support to municipalities, the design of the biological corridor, and better practices for shrimp aquaculture. All these lines of action were described within the context of the biological corridor action plan. During the implementation of this work, it was recommended that degraded areas of the dry forest and swamps be restored and that water quality improve. There was also a focus on ecological system adaptation, taking into account that shrimp aquaculture in many cases had substituted the swamp system.
I.13 Develop incentives to stop further clearing of mangrove for any use (e.g., shrimp ponds, sugarcane)	<p>CODDEFFAGOLF</p> <p><i>Agencia Española de Cooperación Internacional para el Desarrollo (AECID)</i></p> <p>ICF</p> <p>SERNA</p> <p><i>Asociación de Pescadores artesanales</i></p> <p><i>Amigos de la Tierra</i></p> <p><i>Corredor de Mangles</i></p> <p><i>Asociación Civil Trinacional del Golfo de Fonseca (ACTRIGOLFO)</i></p>	<p>All stakeholders are aware of the problems caused by expanding shrimp ponds in some critical areas. To stop such expansion will require law enforcement actions by relevant government agencies (e.g., <i>Dirección General de Pesca y Acuicultura</i> [DIGEPESCA], SERNA, ICF) and also work to empower communities, which focuses on awareness and responsibility.</p> <p>Decreasing the consumption of firewood is only possible if there are viable alternatives. Some projects to promote more efficient stoves that can reduce the use of firewood by 50 percent have been successful in some communities but not in others. Some communities have expressed dissatisfaction with the design and building materials.</p>
I.14 If possible, restore mangroves where they previously existed	<p>CODDEFFAGOLF</p> <p>Shrimp farm industry</p> <p>ANDAH</p> <p>AECID</p> <p>ICF</p> <p>SERNA</p> <p><i>Asociación de Pescadores artesanales</i></p>	<p>All of these groups promote and implement the reforestation and restoration of mangroves.</p> <p>There have been many mangrove reforestation projects in the Gulf region, but none had a scientific foundation on which to base the design of the project, such as an understanding of which areas have the right ecohydrological conditions for which species.</p> <p>For this reason, some mangrove reforestation projects have been successful through lucky choices of areas, and others have failed because of unlucky choices. ICF has extensive experience in reforestation, and CODDEFFAGOLF has coordinated many of the mangrove reforestation projects in the region. It is very important to include <i>curileros</i> in future efforts, because they have a wealth of traditional knowledge about mangroves.</p>

1.15 Remove or redesign infrastructure of commercial shrimp ponds that modify mangrove hydrology and reduce water quality	None	
1.16 Conduct or update studies of main species of commercial importance to the local fishing economy in terms of population dynamics, spawning areas and seasons, as well as other information needed to create species management plans and set quotas	<i>Organización del Sector Pesquero y Acuicola del Istmo Centroamericano (OSPESCA)</i>	A regional study titled, "Sustainable Marine Fisheries Management, With Emphasis On Species Targeted By Sport Fishing" was completed in 2007. It emphasized long-line, artisanal, and industrial fisheries, as well as their relationships to sport fishing of shared target species.
	<p>CEM</p> <p>CODDEFFAGOLF</p> <p>AECID</p> <p><i>Amigos de la Tierra</i></p> <p>USAID Management of Aquatic Resources and Alternative Development (MAREA)</p>	<p>There have been several studies on various species of economic importance. In 2011, the Center for Marine Studies (CEM, <i>Centro de Estudios Marinos</i>), with funding from USAID MAREA, conducted a socio-biological study on curiles, and a management plan was designed for this species in the Gulf. To date, however, there has been no implementation of the majority of the management recommendations.</p> <p>In 2011 CEM, with funding from the <i>Convención Centroamericana de Ambiente y Desarrollo (CCAD)</i> and Zamorano University, conducted a tri-national study on the health of the Gulf of Fonseca marine ecosystem. This study found that four fish species sustain the economy of fishing communities, and these species are in serious jeopardy. Fishing areas were mapped, and fishery indices for monitoring fishing activity by species were developed from a social, biological, and regulatory perspective.</p> <p>With its own funding, CEM has piloted the use of sustainable fishing gear such as shrimp traps as an alternative to the use of trammels. The use of trammels is most common in the Gulf but represents the least sustainable method because of high by-catch rates. CEM has also piloted the development of improved artisanal shrimp ponds that are more ecologically and financially sustainable.</p> <p><i>Amigos de la tierra</i> (Friends of the Earth) and CODDEFFAGOLF just completed a study of the 12 most important fish species in the Gulf, but the results are not yet published.</p> <p>MAREA has worked in collaboration with CODDEFFAGOLF and AECID.</p> <p><i>Amigos de la Tierra</i>, DIGEPESCA, and others have</p>

		<p>participated in a project to protect the olive ridley sea turtle by financing monitoring camps at Cedeño and Venado.</p> <p>AECID developed information on spawning seasons, fishing grounds, and gear used for important species. It also developed recommendations the management of fisheries. Based on some of these recommendations, DIGEPESCA has proposed some seasonal closures and size limits as well as funded projects to exchange fishermen's unsustainable gear for sustainable gear.</p>
I.17 Develop sustainable management plans/regimes for the major economically important fish and shellfish species	USAID MAREA	This project developed a general characterization of seven important coastal and marine species as background information for improving management and finding economic alternatives. Main species studied were bivalves, groupers, snappers, sharks, lobsters, conch, and sea turtles. (2012).
	CEM-MAREA AECID <i>Amigos de la tierra</i>	See explanation for I.17 above.
I.18 Establish "no-take" reserve areas for fish species if needed to rebuild populations, based on scientific knowledge, local knowledge, and community participation	CEM	On the north coast of Honduras, CEM leads a project to design a network of "no-take" reserve areas. Local managers, fishermen, and governments have been supported in participatory management of those areas. A scientific approach was used in the design and establishment of the no-take reserves. Local knowledge also informed this work. At the industrial fishing level, CEM works with the industry and the government to create a management plan that includes no-take reserve areas for major industrial fisheries (shrimp, conch, and lobster).

I.19 Conduct or update studies of use of wood for cooking fuel in all zones	ICF <i>Programa Vida Mejor</i> <i>Ayuda en acción/Acción sur</i>	They conduct comparative studies between traditional and eco stoves.
	State Forest Administration-Honduran Forest Development Corporation (AFE-COHDEFOR)/ <i>Organización Internacional de las Maderas Tropicales</i> (OIMT)/PROMANGLE	An economic appraisal of mangroves in the Gulf of Fonseca was carried out in 55 communities in 2001, and it included information on the use of wood harvested from the mangrove zone.
	ICF AECID USAID MIRA USAID PROARCA COSTA CODDEFFAGOLF	These organizations have conducted evaluations of firewood consumption at the household level and in some cases financed the construction of more fuel-efficient stoves in various communities.
I.20 Conduct or update studies on use of wood for brick and tile making in all zones	ICF	ICF conducted a study on the use of wood for bricks.
	AFE-COHDEFOR/OIMT/PROMANGLE	PROMANGLE activities described above are relevant to this action.
I.21 Conduct or update studies on use of wood for building in all zones	ICF	They update studies on the use of wood for building.
	AFE-COHDEFOR/OIMT/PROMANGLE	PROMANGLE activities described above are relevant to this action.
I.22 Other relevant actions	EAP Zamorano USAID SERN, ICF, CODDEFFAGOLF <i>Mancomunidad de Municipios del Sur</i> (NASMAR), AECID, SAG Union of Municipalities of the Boarder (MAFRON), United Nations Development Programme, <i>Secretaría Técnica de Planificación y Cooperación Externa</i> (SEPLAN) ICF/Programa Nacional Forestal (PRONAFOR) LUPE, Texas A&M	Other relevant activities include: <ul style="list-style-type: none"> • Livelihoods in the Choluteca Watershed; • A protected areas management plan in the southern region of Honduras; • An evaluation report on fishing activity in the Gulf of Fonseca; • An analysis document on climate, social, gender, and temporary recovery risks; • Work that focused on the reduction of vulnerability and natural disasters in the River Choluteca basin; • A watershed-level economic assessment of the downstream effects of steep land erosion on shrimp production in Honduras.

Action for Climate Change Adaptation	Project or Organization	Specific Relevant Experience
2.1 Shift from basic grains to agroforestry crops (e.g., fruits, nuts, coffee) that are not as vulnerable to too much or too little rain because they tap deeper soil water sources and retain soil	Upper Watershed Vegetation Restoration Initiative USAID-Zamorano APROCAFEH, IHCAFE	They promoted watershed recharge zone restoration with coffee and wood tree in the upper Yeguaré River Watershed. Financial aid and some technical assistance.
2.2 Increase market access and strengthen value chains for agroforestry crops	USAID ProParque FHIA/PROPARQUE EAP-ZAMORANO Emprendesur COMRURAL Heifer International	USAID ProParque works with local producers and micro, small, and medium enterprises on various agroforestry products that are key to the economic development of communities and to the well-being of protected areas within 10 protected areas of the Sistema Nacional de Áreas Protegidas y Vida Silvestre de Honduras (SINAPH), including La Tigra NP. There is a focus on: <ul style="list-style-type: none"> • wood, coffee, and fruit; • cocoa; • cashew nuts; • coffee; and • fruits and vegetables.
2.3 Increase access to water on small farms and increase efficiency of use through practices and technology	Watershed Management in Rio Negro, Rio Choluteca, Zamorano USAID Oxfam Quebec CARE PROSADE Heifer International FORCUENCAS	They have experience implementing drip irrigation systems, small-scale water harvesting ponds for irrigation, water harvesting for domestic use, well drilling, and small water retention structures (micro dams).
2.4 Increase water use efficiency in commercial agro industries (e.g., melons, sugarcane)	<i>Agrolibano</i> <i>Excotur</i> <i>Azucarera Choluteca, La Grecia</i>	They have experience with drip irrigation in the whole melon cultivated area, starting in sugar cane; construction of water harvesting ponds; and monitoring the dynamic of superficial and ground water.
2.5 Increase cultivation of coffee varieties resistant to coffee leaf rust fungus (<i>roya</i>)	IHCAFE FHIA	IHCAFE has conducted studies in this area.

2.6 Increase use of climate-smart varieties of basic grains (i.e., those adapted for the kinds of climate variability that exists now, and that is predicted)	<p>SAG/ Dicta</p> <p>INSTORMIL</p> <p>FHIA</p> <p>Zamorano</p> <p><i>Centro Agronómico Tropical de Investigación y Enseñanza (CATIE)</i></p> <p>CIAT</p>	They have experience with maize, sorghum, and beans.
2.7 Develop tourism options in fishing communities (e.g., restaurants, mangrove tours, birdwatching, sea turtle viewing)	<p>The whole country:</p> <p>SAG/DIGEPESCA</p> <p>SERNA</p> <p><i>Secretaria de Turismo</i></p> <p>Southern Honduras:</p> <p>ANDAH/PNUD</p> <p>CODDEFFAGOLF</p> <p><i>Asociación de Pescadores artesanales</i></p> <p>AECID</p> <p>Northern Honduras:</p> <p><i>Fundación Pico Bonito</i></p> <p><i>Fundación Cayos Cochinos</i></p> <p><i>Fundación Cuero y Salado</i></p> <p>USAID ProParque</p> <p><i>Fundación Janeth Kawas</i></p>	<p>Work focuses on capacity strengthening of the stakeholder in tourism.</p> <p>These groups provided financial assistance to support a sea turtle harvest ban, an eco-restaurant and lodge in the mangroves, tourism in mangroves and estuaries, and boat rides.</p> <p>These groups promoted an eco-restaurant and lodge, biological tourism, snorkeling, canopy rides, canoeing, hiking and nature trails in protected areas, adventure tourism, diving, and boat rides.</p>
	<p>CODDEFFAGOLF</p> <p>AECID</p> <p>MAREA</p> <p><i>Corredor del mangle</i></p>	<p>Several projects to promote tourism have been carried out. In some cases, these projects have involved building infrastructure (e.g., viewpoints, docks, visitor centers, road improvements, small restaurants) or provided training to groups of women (e.g., in cooking, customer relations) and men (e.g., in tour guiding). However, the communities report a decline in the number of tourists and income from tourism. Difficult access, lack of a local tourist culture, and lack of appropriate facilities could be some of the causes.</p> <p>In 2007, CODDEFFAGOLF drafted a proposal to create a rural eco-tourism circuit in the Bahía de Chismuyo protected area that connects to four municipalities in two commonwealths (NASMAR and MAFRON).</p>

2.8 Reduce fuel wood use/demand through improved cook stoves or substitute fuels	<p><i>Programa Vida Mejor de Presidencia de la República</i></p> <p>Oxfam Quebec</p> <p>CARE PROSADE</p> <p>Lempira Sur</p> <p><i>Proyecto LUPE</i></p> <p>Zamorano</p> <p><i>Amigos de la Tierra</i></p> <p><i>Médicos sin Frontera</i></p> <p>ANAF AE</p> <p><i>Asociación de Organismos No Gubernamentales de Honduras (ASONOG)</i></p>	Because of its impact, public and private organizations promote this technology throughout the country.
	Regional Energy & Poverty Program in Central America (PREPCA) in collaboration with the Humanist Institute for Cooperation (HIVOS)	The PREPCA program, in collaboration with HIVOS, has begun to facilitate knowledge-sharing experiences and best practices as part of the Green Entrepreneurship Program, implemented by HIVOS from 2011 to 2015. One aspect deals with promoting a variety of improved fuel-efficient stoves.
	<p>ICF</p> <p>AECID</p> <p>USAID MIRA</p> <p>USAID PROARCA COSTA</p> <p>CODDEFFAGOLF</p> <p>USAID MAREA</p>	See I.20 above.
2.9 Reduce fuelwood use for brick-kilning through improved kiln designs	PREPCA in cooperation with HIVOS	This work is also relevant to activities focusing on improving kilns for brick/tile-making.
2.10 Design and build infrastructure to accommodate rainfall and river flows greater than historical averages	USAID (post-Mitch program)	This work focuses on the lowest part of Aguan and Choluteca river watershed.

2.11 Encourage maize farmers not to plant immediately after early first rains in the first wet season, but to wait until historical dates for the start of the main rains (e.g. mid-May)	<p>Oxfam Quebec</p> <p>CARE PROSADE</p> <p>Lempira Sur</p> <p><i>Proyecto LUPE</i></p> <p>Zamorano</p> <p><i>Amigos de la Tierra</i></p> <p><i>Médicos sin Frontera</i></p> <p>ANAFAE</p> <p>ASONOG</p> <p>FAO</p> <p>FHIA</p>	These organizations have provided extension assistance to farmers to encourage planting crops at the proper time of year, based on historical precipitation information (amount and distribution).
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Action for Climate Change Adaptation	Project or Organization	Specific Relevant Experience
3.1 National agencies (SERNA, ICF, and DIGIPESCA) enforce current laws better and control corruption that leads to violations of environmental laws and regulations	SERNA/ <i>Departamento de Minas e Hidrocarburos</i> , ICF, SAG/DIGIPESCA, <i>Ministerio Público/Fiscalía del Ambiente</i> , Municipalities, UMA, INA, <i>Secretaría de Turismo</i>	<p>All of these groups should regulate and implement the control of available natural resources and their services, but there are contradictions among the groups, their laws, and their rules.</p> <p>ICF and the <i>Ministerio Público</i> control illegal wood and fuelwood extraction, as well as some wildlife in the protected area. These laws are not applied with equity.</p>
3.2 Improve communication and collaboration between national agencies, co-management agencies, municipalities, and communities for better local monitoring and enforcement of laws and regulations	None	
3.3 Revise management plans of all protected areas to adapt conservation management for projected climate changes	ICF/CODDEFFAGOLF	After the team's comprehensive review of the management plans for the 11 protected areas in the Gulf of Fonseca, the team found that only the management plan for the Bahía de Chismuyo protected area contains provisions for adaptation to climate change.
3.4 Improve watershed-scale planning and management (i.e.,	CATIE/GTZ	Pilot projects in Valle de Angeles (La Soledad, Watershed) and Copan Ruins.

improve capacity for integrated watershed management)	MIRA Project/Zamorano/USAID	They are implementing a participatory method for the formulation of micro-watershed plans in Choluteca and Aguan River watersheds.
3.5 Improve integrated planning and management for the coastal zone that recognizes the eco-hydrological linkages between inland and open waters of the Gulf (i.e., improve integrated coastal zone management)	USAID MAREA/The Nature Conservancy (TNC)	TNC will secure high-level commitments by political and private sector leaders and other stakeholders with ecosystem-based measures to adapt to climate change that can drive better decision-making and provide an impetus to many of the needed fundamental reforms and actions. The commitments will include a set of principles and best practices that would guide development projects and conservation actions; for example, best practices for new coastal construction, land use zoning and densities, and protection of critical habitats.
3.6 Develop local and regional schemes for payment/compensation for ecosystem services for water	Zamorano/ <i>Fundación Vida Rio Neteapa</i> , Choluteca River Watershed <i>Juntas de Administradora de Agua Potable y Disposición de Excretas (JAPOE), Jesús de Otoro, Intibucá</i>	In both cases, a fee for restoration and management of the micro-watershed recharge areas is included in the water tariff.
	USAID ProParque	This project has worked at the local and/or municipal level to establish arrangements for payments for environmental services, as in the case of the municipality of Olanchito, Yoro.
	<i>Comisión Nacional de Bienes y Servicios Ambientales (CONABISAH)</i>	CONABISAH, following the guidelines of the National Strategy for Environmental Goods and Services, promotes the establishment of mechanisms for financial or other compensation to maintain and restore environmental services.

ANNEX I. CASE STUDY – TRES VALLES SUGAR COMPANY AND WATERSHED RESTORATION

Improving water management and water-use efficiency is at the center of decision making for a sugarcane agribusiness. The Tres Valles Sugar Company provides an example of the proactive approach of a sugarcane company that is looking for win-win options (company and community) in terms of water access, efficiency management, and watershed protection. Tres Valles Sugar Company is a leader in Honduras in sugarcane production with highly efficient use of water. This company has its main production fields in the Moroceli Valleys in the Francisco Morazán Department, where it grows approximately 5,500 hectares of sugarcane, most with drip irrigation. The company also rents land or buys sugarcane from private producers in the Yeguaré and Talanga valleys, which is the origin of the name “Tres Valles.”

YEGUARE VALLEY SUGARCANE FIELDS



Photo by L. Caballero

For more than a decade, Tres Valles has applied an evolving strategy for crop, land, and water management. The two main objectives have been to increase production areas and increase yields in terms of tons of sugarcane per hectare. In both objectives, water management was at the center of decision making. Tres Valles managers knew that water supply was limited, and the expansion of production areas could be limited by lack of water. The company thus began collecting data on streamflow in five major water sources, including the Rio Choluteca before and after it passes through

the valleys as well as other stations in between. These measurements were intended to help the company better understand the water cycle in the valley. As water demand and competition increased, they began collecting streamflow data on other tributaries such as the Rios Suyapa, Chiquito, Liquitimaya, Yeguaré, and Netiapa.

According to the team's analysis, there were two major reasons for their proactive water management strategy. The first was to improve water efficiency in order to expand the area of crop production using saved water. The second was to increase sugarcane productivity from 60-70 Ton/Ha to 90-100 Ton/Ha. These decisions were based on research results from different irrigation technologies. Through more than 20 years in the sugar business, this company has moved gradually from flood to sprinkler irrigation, and more recently to drip irrigation. In all of this change, water was at the center of decision making. As they summarized, "We have land, but what limits our growth is water."

Drip irrigation is known to be 30-40 percent more efficient than flood and sprinkler irrigation, so less energy is used to pump water from rivers or groundwater aquifers. Companies usually gradually make changes in irrigation technology, waiting until cost and/or savings justify a more water efficient option. If a water source is abundant and gravity fed (using no energy for pumping), there is little incentive to conserve water. As surface water becomes scarce, the next water source is groundwater, but that has increased costs due to energy needs for pumping and transmission. This option creates some incentives for savings in energy through improved water efficiency. If groundwater is also scarce, they invest in building small dams (water detention walls in small streams) to store surface runoff and/or divert it to storage lagoons for later use (Agrolibano in Choluteca is an example of the use of this practice). All of these water supply alternatives have incremental costs per unit of water (m³) and are not purchased until they have to be. Tres Valles has already invested in most of the higher-value water efficiency options and is the most water-efficient sugar company in the region.

Tres Valles identified a few watersheds in their growing area where they are already investing funds to monitor climate and streamflow, to protect forest cover, to restore permanent land cover through reforestation, and to help communities to better manage their lands. They co-manage this work with the Forest Conservation Institute of the Chile Biological Reserve. Aside from protecting natural resources and improving community participation, they plan to create a program to incentivize farmers to plant more trees and build small reservoirs and ponds to contain runoff and increase groundwater recharge.

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